Question Bank

BE 3/4 CSE Sem I, Sec E, F, G Sub: ALC

UNITS III, IV & V

Q. What are the normal forms of CFG's? What are the eliminations or simplifications to be made to a grammar before converting it into a CNF?

a) 1. Remove unit productions from the following CFG.

$S \to AA$, $A \to B/BB$, $B \to abB/b/bb$

2. Eliminate ϵ-productions from the following CFG.

$S \to ABa|bC$, $A \to BC|b$,
$B \to b|\epsilon$, $C \to c|\epsilon$

3. Remove useless symbols from the following CFG.

$S \to aAa$, $A \to Sb|bCC|DaA$, $C \to abb|DD$,
$E \to aC$, $D \to aDA$

b) Convert the following grammars to CNF.

1. $S \to aB|ab$, $A \to aAB|a$, $B \to ABb|b$
2. $S \to bA|aB$, $A \to bAA|aS|a$, $B \to aBB|bS|b$
3. $S \to aSb|ab$
4. $E \to E+T|T$, $T \to T*F|F$, $F \to (E)|a$
5. $S \to iCtS|iCtSeS|a$, $C \to b$
6. $S \to AA$, $A \to B|BB$, $B \to abB|b|bb$
7. $S \to aAa|aBC$, $A \to aS|bD|\epsilon$, $B \to aBa|C|b$
   $C \to abb|DD$, $D \to aDa$
8. $S \to ABa|bC$, $A \to BC|b$, $B \to b|\epsilon$, $C \to c|\epsilon$

c) Convert the following grammars into GNF.

1. $S \rightarrow AA \mid 0$, $A \rightarrow SS \mid 1$
2. $A \rightarrow BC$, $B \rightarrow CA \mid b$, $C \rightarrow AB \mid a$

II a) What are the closure and decision properties of CFL's ?

b) State and prove pumping lemma for CFL's. What are its applications ?

c) Using pumping lemma prove that the following languages are not CFL's.

1. $L = \{ ww \mid w \in \{0,1\}^* \}$
2. $L = \{ 0^n 1^n 0^n 1^n \mid n \geq 0 \}$

III Consider the CFG : $S \rightarrow A_1A_2 \mid A_2A_3$, $A_1 \rightarrow A_2A_1 \mid 0$, $A_2 \rightarrow A_3A_3 \mid 1$, $A_3 \rightarrow A_1A_2 \mid 0$

Test if "10010" is a member of the CFG or not using CYK algorithm.

IV. a) Give short notes on DCFLs.

b) Define LR(0) and LR(k) grammars.

V Construct the nonempty sets of items for the following grammars. Which are LR(0) ?

1. $A \rightarrow (A) \mid a$
2. $S \rightarrow AaAb \mid BbBa$, $A \rightarrow \epsilon$, $B \rightarrow \epsilon$
3. $E \rightarrow E*B \mid E+B \mid B$, $B \rightarrow 0 \mid 1$

4. $E \rightarrow E+T \mid T$, $T \rightarrow T*F \mid F$, $F \rightarrow (E.) \mid id$

5. $S' \rightarrow S$, $S \rightarrow aSa \mid bSb \mid \epsilon$

VI a) State and explain programming techniques for Turing Machines

b) State and explain the extensions to the basic Turing Machines.

VII a) Define a TM ? What are the languages accepted by a TM ? Give applications for TMs.

b) Define 'δ' and 'ID' of a TM.

VIII: a) Define CHURCH's hypothesis.

b) Write short notes on (i) Restricted TMs (ii) UTMs.

IX. a) Differentiate between FA, PDA and TMs.

b) Explain TM as a Transducer and Enumerator.

c) Give Reasons for TM not accepting input.

X Design Turing Machines for the following :

1. To recognize all bit strings ending in 101.
2. To accept $a^n b^n a^n \mid n \geq 1$
3. For multiplication of two numbers M x N (separated by '1')
4. To accept a palindrome consisting of a's and b's of any length.
5. $L = \{ ww \mid w \in \{0,1\}^* \}$ & $L = \{ w \# w \mid w \in \{0,1\}^* \}$
6. To recognize the set of all bit strings that contain an even no. of 1's.

7. $L = \{a^n b^n \mid n \geq 1\}$

8. To add 2 non negative integers.

9. For equal no. of a's & b's.

10. For subtraction of 2 non negative integers.

XI. Write short notes on:

a) CHOMSKY Hierarchy b) Recursively Enumerable Languages and their properties c) Undecidability with an example d) LBA e) Intractable problems (P, NP, NP-Hard, NP-Complete)

XII a) What is the Halting problem of a TM?

b) Give 2 examples of (i) Unrestricted grammars (ii) CSGs

XIII Write about: a) Rice theorm b) CSLs c) SAT and RSAT problems d) Diagonalization Language.

XIV a) Compare Rt. linear grammar and Left linear grammar.

b) Give RLG and LLG for i) $(0+1)^* 00 (0+1)^*$

ii) $0(10)^*$ iii) $10 + (0+11)0^*1$ iv) $ba^*(b+ba)$

v) $0^*(1(0+1))^*$

XV a) Differentiate between PCP and MPCP.

b) Do the given PCP's have a solution?

1. $X = (011, 11, 1101)$ $Y = (101, 011, 110)$

2. $X = (1, 10111, 10)$ $Y = (111, 10, 0)$

3. $X = (10, 011, 101)$ $Y = (101, 11, 011)$